Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] An article comprising a substrate and a coating system on a surface of the substrate, the substrate being formed of a metal alloy containing more than 3 weight percent rhenium and at least one refractory metal selected from the group consisting of tungsten, tantalum, hafnium, molybdenum, niobium, and zirconium, the coating system comprising an aluminum-containing overlay coating and a diffusion barrier coating between the overlay coating and the substrate, the diffusion barrier coating consisting of, in atomic percent, about 20% to about 90% ruthenium, about 2% to about 60% chromium, optionally up to about 50% aluminum, optionally up to about 20% of a platinum-group metal, and the balance essentially at least one of nickel, cobalt, and iron, the substrate being essentially free of a secondary reaction zone that is deleterious to the mechanical properties of the metal alloy.

[c2] The article according to claim 1, wherein the overlay coating comprises a metallic solid solution containing intermetallic phases, and has a composition of MCrAlX, where M is iron, cobalt and/or nickel, and X is at least

one rare earth element.

[c3] The article according to claim 2, wherein the overlay coating contains, in atomic percent, about 10% to about 40% aluminum, 10% to about 25% chromium, 0.2% to about 3% yttrium, and the balance essentially at least one of nickel, cobalt, and iron.

[c4] The article according to claim 1, wherein the overlay coating consists essentially of intermetallic phases.

[c5] The article according to claim 4, wherein the overlay coating contains, in atomic percent, about 30% to about 60% aluminum, optionally up to about 10% chromium, 0.1% to about 1.2% of at least one element chosen from the group consisting of zirconium, hafnium, silicon, and titanium, the balance being essentially nickel.

[c6] The article according to claim 1, further comprising a ceramic coating on the overlay coating.

[c7] The article according to claim 6, wherein the ceramic coating contains yttria-stabilized zirconia.

[c8] The article according to claim 7, wherein the ceramic coating contains about 7 to about 8 weight percent yttria.

[c9] The article according to claim 6, wherein the ceramic

coating further contains an oxide of a lanthanide-series element.

[c10] The article according to claim 1, wherein the metal alloy of the substrate is a superalloy containing at least four weight percent rhenium.

[c11] The article according to claim 1, wherein the diffusion barrier coating consists of, in atomic percent, about 30% to about 80% ruthenium, about 2% to about 12% chromium, about 4% to about 10% aluminum, optionally up to about 20% of a platinum-group metal, and the balance nickel and/or cobalt and incidental impurities.

[c12] The article according to claim 1, wherein the article is a gas turbine engine component.

[c13] A gas turbine engine component comprising a substrate and a coating system on a surface of the substrate, the substrate being formed of a nickel-base superalloy containing about 4.5 to about 5.75 weight percent rhenium and at least one refractory metal selected from the group consisting of tungsten, tantalum, hafnium, molybdenum, niobium, and zirconium, the coating system comprising: a diffusion barrier coating on the substrate and consisting of, in atomic percent, 30% to 80% ruthenium, 2% to 12% chromium, about 4% to about 10% aluminum, op-

tionally up to 20% of a platinum-group metal, and the balance being nickel and/or cobalt and incidental impurities; and

an overlay coating on the diffusion barrier coating and consisting essentially of intermetallic phases and containing, in atomic percent, 30% to 60% aluminum, optionally up to 10% chromium, 0.1% to 1.2% of at least one element chosen from the group consisting of zirconium, hafnium, silicon, and titanium, the balance being essentially nickel;

wherein the diffusion barrier coating inhibits diffusion of aluminum from the overlay coating into the substrate so that the substrate is essentially free of a secondary reaction zone that is deleterious to the mechanical properties of the superalloy.

[c14] The gas turbine engine component according to claim 13, further comprising a ceramic coating on the overlay coating.

[c15] The gas turbine engine component according to claim 14, wherein the ceramic coating contains yttria-stabilized zirconia.

[c16] The gas turbine engine component according to claim 15, wherein the ceramic coating further contains an oxide of a lanthanide-series element.

[c17] The gas turbine engine component according to claim 13, wherein the superalloy of the substrate consists of, by weight, 0.4% to 6.5% ruthenium, 4.5% to 5.75% rhenium, 5.8% to 10.7% tantalum, 4.25% to 17.0% cobalt, up to 0.05% hafnium, up to 0.06% carbon, up to 0.01% boron, up to 0.02% yttrium, 0.9% to 2.0% molybdenum, 1.25% to 6.0% chromium, up to 1.0% niobium, 5.0% to 6.6% aluminum, up to 1.0% titanium, 3.0% to 7.5% tungsten, and wherein the sum of molybdenum plus chromium plus niobium is 2.15% to 9.0%, and wherein the sum of aluminum plus titanium plus tungsten is 8.0% to 15.1%, the balance nickel and incidental impurities.

[c18] The gas turbine engine component according to claim 17, wherein the diffusion barrier coating consists of, in atomic percent, 40% to 60% ruthenium, 5% to 12% chromium, 4% to 8% aluminum, and the balance nickel and/or cobalt and incidental impurities.

[c19] The gas turbine engine component according to claim 13, wherein the diffusion barrier coating consists of, in atomic percent, 40% to 60% ruthenium, 5% to 12% chromium, 4% to 8% aluminum, and the balance nickel and/or cobalt and incidental impurities.

[c20] The gas turbine engine component according to claim

13, wherein the diffusion barrier coating consists of, in atomic percent, about 43% ruthenium, about 9% chromium, about 5% aluminum, and the balance nickel and incidental impurities.